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An Annotated Bibliography of Recent Elasticity and Flexibility Estimates for Meat and Livestock

William F. Hahn

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An Annotated Bibliography of Recent Elasticity and Flexibility Estimates for Meat and Livestock. By William F. Hahn. Commercial Agriculture Division, Economic Research Service, U.S. Department of Agriculture. Staff Paper No. AGES-9611

Abstract

Supply and demand models are an important part of economic theory and these models underlie much of the applied work done by economists. To answer questions about the effects of specific shocks to a sector, economists need estimates of the relevant supply and demand elasticities. To support the applied analysis of the Animal Products Branch, this bibliography of recent empirical estimates of U.S. demand and supply elasticities for livestock, meat, and poultry was compiled. Each reference is followed by a brief discussion of the techniques and data used and (usually) tables showing the estimated elasticities.

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An Annotated Bibliography of Recent

Elasticity and Flexibility Estimates for Meat and Livestock

By

William F. Hahn

Alston, Julian M., and James A. Chalfant (1993). "The Silence of the Lambdas: A Test of the Almost Ideal and Rotterdam Models." *American Journal of Agricultural Economics*, Vol. 75, No. (2), (May 1993) pp. 304-313.

Compared two econometric demand systems for their ability to explain quarterly U.S. meat demand for the years 1967 through 1988. Both systems were consistent with the theory of demand. They concluded that the Rotterdam model was superior. The elasticities implied by their Rotterdam estimates are:

Alston and Chalfant's elasticity estimates

	Beef price	Chicken price	Pork price	Fish price	Meat expend-itures
Beef quantity	-0.98	-0.03	-0.12	-0.12	1.25
Chicken quantity	0.04	-0.94	-0.09	-0.07	1.06
Pork quantity	-0.02	0.02	-0.17	0.00	0.17
Fish quantity	-0.21	-0.04	-0.03	-0.23	0.52

Brester, Gary W., and Michael K. Wohlgenant (1993). "Correcting for Measurement Error in Food Demand Estimation." *Review of Economics and Statistics,* Vol. 75, No. 2, (May 1993) pp. 352-356.

Estimated retail level elasticities of the demand for beef allowing for the possibility of input substitution in the production of retail beef from wholesale beef using annual data from 1955 through 1987. Found the following elasticity estimates:

Brester and Wohlgenant's 1993 retail beef demand elasticities

Elasticity of the retail demand for beef with respect to:			
Beef price	Pork price	Chicken price	Income
-0.45	0.10	0.37	0.26

Brester, Gary W., and Michael K. Wohlgenant (1991). "Estimating Interrelated Demands for Meats Using New Measures for Ground and Table Cut Beef." *American Journal of Agricultural Economics*, Vol. 73, No. 4, (November 1991) pp. 1182-1194.

Estimated a theoretically consistent demand system for meat with beef split into table cuts and hamburger using annual data from 1962 to 1989. Their results are:

Brester and Wohlgenant's 1991 meat demand elasticities

	With respect to the price of--					
Elasticity of the quantity of--	Ground beef	Other beef	Pork	Poultry	Other goods	Income
Ground beef	-1.015	0.408	0.348	0.241	0.016	-0.197
Other beef	0.136	-0.811	0.094	-0.040	0.619	0.805
Pork	0.158	0.128	-0.779	0.030	0.461	0.343
Poultry	0.225	-0.112	0.062	-0.296	0.121	0.417

Capps, Oral, Jr. (1989). "Utilizing Scanner Data to Estimate Retail Demand Functions for Meat Products." *American Journal of Agricultural Economics,* Vol. 71, No. 3, (August 1989) pp. 750-760.

Estimated demand elasticities, advertising effects, and season effects for several meat cuts using scanner data from a Houston grocery chain. The data were collected weekly between January 1986 and June 1987. His estimated price elasticities are:

Capps' retail meat cut demand elasticities

Quantity variable	Price variable			
	Steak	Ground beef	Roast beef	Non-beef
Steak	-0.72	0.75	0.20	0.80
Ground beef	0.57	-0.15	0.00	0.42
Roast beef	0.54	0.86	-1.27	1.45

Quantity variable	Price variable	
	Chicken	Non-poultry
Chicken	-0.66	0.70

Quantity variable	Price variable				
	Pork chops	Ham	Pork loin	Composite pork chops and pork loin	Non-pork
Pork chops	-0.70	-0.44			1.44
Ham		0.36		-0.26	2.86
Pork loin		-0.34	-0.83		1.59

Capps, Oral, Jr., Donald E. Farris, Patrick J. Byrne, Jerry C. Namken, and Charles D. Lambert (1994). "Determinants of Wholesale Beef-Cut Prices." *Journal of Agricultural and Applied Economics,* Vol. 26, No. 1, (July 1994) pp. 183-199.

Estimated a dynamic, wholesale demand for beef cuts using monthly data from January 1980 to December 1990 and found the following demand flexibilities:

Capps, Farris, Byrne, Namken, and Lambert's wholesale beef cut demand flexibilities

Wholesale beef cut: number and name	Flexibilities of demand					
	Own quantity (for beef cuts)	Cross beef quantity	Pork quantity	Chicken quantity	Coefficient of adjustment	Own quantity, longrun
184, top sirloin	-0.20	0.03	0.33	-0.04	0.36	-0.54
189, tenderloin	-0.29	-0.10	0.28	-0.07	0.30	-0.98
193, flank	-0.51	0.15	0.31	-0.25	0.60	-0.85
Fresh 90 percent	-0.03	-0.11	0.05	-0.04	0.10	-0.31
Fresh 50 percent	-0.95	0.19	0.12	0.21	0.31	-3.01
Pork		0.23	-0.26	-0.09	0.53	-0.50
Chicken		0.05	0.22	-0.41	0.24	-1.67

Choi, Seungmook, and Kim Sosin (1990). "Testing for Structural Change: The Demand for Meat." *American Journal of Agricultural Economics,* Vol. 72, No. 1, (February 1990) pp. 227-236.

Tested for structural changes in meat demand using translog demand function and annual data from 1953 to 1984. (The translog demand function is consistent with the economic theory of demand.) Found evidence of taste shifts away from red meat and toward poultry. Their elasticity estimates are:

Elasticity of the quantity demanded of--	With respect to the price of--			With respect to income
	Red meat	Poultry	Other goods	
Red meat	-0.971	-0.013	-1.105	2.090
Poultry	-0.010	-0.893	-0.937	1.841
Other goods	-0.010	-0.002	-0.523	0.536

Eales, James S. (1994). "The Inverse Lewbel Demand System." *Journal of Agricultural and Resource Economics*, Vol. 19, No. 1, (July 1994) pp. 173-182.

Developed a new model of consumer demand (inverse Lewbel demand system), which nests the inverse almost ideal demand system and the direct translog system, two other systems that are also consistent with the theory of demand. Used quarterly data from 1966 to 1992, inclusive, to estimate the following flexibilities for U.S. meat demand:

Flexibility of the price of--	With respect to the quantity of--			
	Beef	Pork	Chicken	Scale
Beef	-0.75	-0.06	-0.05	-0.86
Pork	-0.24	-0.73	-0.07	-1.04
Chicken	-0.62	-0.31	-0.63	-1.56

Eales, James S., and Laurian J. Unnevehr (1994). "The Inverse Almost Ideal Demand System." *European Economic Review*, Vol. 38, No. 1, (January 1994) pp. 101-115

Developed the Inverse Almost Ideal Demand System, a theoretically consistent inverse demand system, and used it to estimate U.S. meat demand using quarterly data from 1966 through 1988. Their estimated flexibilities of demand are:

Eales and Unnevehr's 1994 flexibility estimates

Flexibility of the price of--	With respect to the quantity of--		
	Beef	Pork	Chicken
Beef	-0.75	-0.04	-0.05
Pork	-0.19	-0.79	-0.05
Chicken	-0.75	-0.37	-0.61

Eales, James S., and Laurian J. Unnevehr (1993). "Simultaneity and Structural Change in U.S. Meat Demand." *American Journal of Agricultural Economics*, Vol. 75, No. 2, (May 1993) pp 259-268.

Another paper trying to test for structural change in U.S. meat demand using theoretically consistent demand systems. Estimated both direct and indirect demand systems using annual data from 1962 to 1989. After correcting for simultaneity bias using three-stage least squares, found no evidence of structural changes in meat demand. Their three-stage-least-squares estimates are presented below.

Eales and Unnevehr's 1993 elasticity estimates

	Change in price of--					
Change in quantity of--	Beef	Pork	Chicken	Non-meat food	All other goods	Income
Beef	-0.850	-0.045	0.070	0.644	-0.609	0.791
Pork	-0.107	-1.234	0.013	1.694	-1.645	1.281
Chicken	0.385	0.041	-0.233	-0.381	-0.505	0.693
Non-meat food	0.129	0.156	-0.009	-1.197	0.769	0.153
All other goods	-0.032	-0.026	-0.006	-0.009	-1.103	1.175

Eales and Unnevehr's 1993 flexibility estimates

	Change in quantity of--					
Change in price of--	Beef	Pork	Chicken	Non-meat food	All other goods	Income[1]
Beef	-1.189	-0.040	-0.168	-0.351	0.464	1.000
Pork	-0.073	-0.879	-0.093	-0.928	1.061	1.000
Chicken	-0.939	-0.258	-2.257	-2.544	4.167	1.000
Non-meat food	-0.072	-0.088	-0.079	-0.413	-1.035	1.000
All other goods	0.028	0.019	0.031	-0.075	-0.851	1.000

[1] Theoretical restrictions force income flexibities to be exactly 1.

Eales, James S., and Laurian J. Unnevehr (1988). "Demand for Beef and Chicken Products: Separability and Structural Change." *American Journal of Agricultural Economics*, Vol. 70, No. 3, (August 1988) pp. 521-532.

Estimated a theoretically consistent, complete demand system for whole chickens, chicken parts, hamburger, table cuts of beef, pork, non-meat foods, and all other goods using annual data from 1965 to 1985. They presented compensated elasticities and expenditure elasticities. Regular elasticities of demand were calculated based on the reported average budget shares, expenditure elasticities, and compensated elasticities. Elasticities of demand are presented below:

Eales and Unnevehr's 1988 elasticity estimates

Key:

WHL	Whole birds	PK	Pork
P&P	Parts & processed chicken	OF	Other foods
		AOG	All other goods
HB	Hamburger	EXP	Expenditures
TC	Table cuts of beef		

Compensated elasticities as presented by Eales and Unnevehr

	WHL	P&P	HB	TC	PK	OF	AOG
WHL	-0.68	0.43	0.60	-0.18	-0.20	0.32	-1.54
P&P	0.46	-0.61	-0.12	-0.21	0.32	-1.10	1.09
HB	0.35	-0.07	-2.59	1.59	0.59	0.31	-2.75
TC	-0.02	-0.02	0.38	-0.68	-0.02	-0.33	1.26
PK	-0.04	0.06	0.21	-0.06	-0.57	-0.11	-0.46
OF	0.01	-0.02	0.02	-0.06	0.00	-0.61	0.10

Uncompensated elasticities calculated based on Eales' and Unnevehr's information

	WHL	P&P	HB	TC	PK	OF	AOG	EXP
WHL	-0.68	0.43	0.60	-0.17	-0.19	0.36	-1.34	-0.25
P&P	0.46	-0.61	-0.12	-0.23	0.30	-1.24	0.43	0.83
HB	0.35	-0.07	-2.59	1.62	0.61	0.57	-1.50	-1.57
TC	-0.02	-0.03	0.38	-0.72	-0.04	-0.58	0.02	1.57
PK	-0.04	0.06	0.21	-0.06	-0.57	-0.11	-0.49	0.04
OF	0.01	-0.02	0.02	-0.07	0.00	-0.68	-0.24	0.43

Foster, Kenneth A., and Oscar R. Burt (1992). "A Dynamic Model of Investment in the U.S. Beef-Cattle Industry." *Journal of Business and Economic Statistics,* Vol. 10, No. 4, (October 1992) pp. 419-426.

Estimated cow-herd response to price changes using *a priori* information on reproduction constraints and annual data from 1965 to 1990. Found the following calf price (supply) elasticities for cow herd and replacement heifers:

Foster and Burt's cow-calf operators' supply elasticities

Lag length in years								
1	2	3	4	5	6	10	15	Long-run
Replacement heifers								
0.152	0.351	0.527	0.740	0.881	0.964	1.08	1.21	1.33
Mature cow herd								
0.000	0.153	0.289	0.411	0.522	0.621	0.886	1.04	1.17

Gao, X. M., and J. S. Shonkwiler (1993). "Characterizing Taste Change in a Model of U.S. Meat Demand: Correcting for Spurious Regression and Measurement Errors." *Review of Agricultural Economics*, Vol. 15, No. 2, (May 1993) pp. 313-324.

Estimated demands for beef, pork, and chicken correcting for possible changes in taste using a theoretically consistent demand system and annual data from 1956 to 1987. Demand elasticities implied by their estimates are:

Gao and Shonkwiler's meat demand elasticities

Elasticity of demand for--	With respect to price of--			Meat Expenditures
	Beef	Pork	Chicken	
Beef	-1.03	-0.06	-0.10	1.19
Pork	-0.07	-0.95	-0.10	1.12
Chicken	0.23	0.11	-0.47	0.12

Hahn, William F. (1994). "A Random Coefficient Meat Demand Model." *Journal of Agricultural Economics Research,* Vol. 45, No. 3, (Fall 1994) pp. 21-30.

Estimated U.S. meat demands using a theoretically consistent, random coefficient system and monthly data from 1981 to 1992. Found that meat demand parameters were random over time. Elasticities of demand evaluated at average budget shares and average coefficient estimates are:

Hahn's 1994 meat demand elasticities

	Beef price	Pork price	Chicken price	Turkey price	Meat expenditure
Beef quantity	-0.869	-0.095	-0.117	-0.020	1.101
Pork quantity	-0.090	-0.699	-0.143	-0.010	0.941
Chicken quantity	-0.298	-0.256	-0.299	-0.058	0.911
Turkey quantity	0.080	0.070	-0.147	-0.459	0.456

Hahn, William F. (1988) "Effects of Income Distribution on Meat Demand." *Journal of Agricultural Economics Research,* Vol. 40, No. 2, (Spring 1988) pp. 19-24.

Estimated log-linear demand functions for beef, pork, and chicken with an attempt to correct for shifts in the distribution of income and annual data from 1960 to 1984. The estimated elasticities were not required to be consistent with the restrictions of demand theory. Estimated elasticities of demand were:

Hahn's 1988 demand elasticities

	Beef price	Pork price	Chicken price	Income
Beef quantity	-0.58	0.08	0.05	0.92
Pork quantity	0.44	-0.78	0.07	-0.02
Chicken quantity	0.15	-0.08	-0.14	-0.57

Heien, Dale, and Greg Pompelli (1988). "The Demand for Beef Products: Cross-Section Estimation of Demographic and Economic Effects." *Western Journal of Agricultural Economics*, Vol. 13, No. 1, (July 1988) pages 37-44.

Estimated the demand for beef cuts using cross-sectional data (from 1977) and a system that is consistent with demand theory. Their beef-cut demand elasticities are:

Heien and Pompelli's beef product demand elasticities

Elasticity of demand for--	With respect to price of--			Beef expenditures
	Steak	Roast	Ground beef	
Steak	-0.73	-0.17	-0.24	1.14
Roast	-0.39	-1.11	0.13	1.37
Ground beef	-0.05	0.21	-0.85	0.69

Holt, Matthew T., and Stanley R. Johnson (1988). "Supply Dynamics in the U.S. Hog Industry." *Canadian Journal of Agricultural Economics*, Vol. 36, No. 2, (July 1988) pp. 313-335.

Estimated a quarterly econometric model of the U.S. hog supply using data from 1967 to 1985. Model explains breeding herd, sow slaughter, pig crop, barrow and gilt slaughter, and farm pork production. Produced the following elasticity estimates:

Holt and Johnson's hog supply elasticities

Length of run in quarters:		0	1	2	3	4	8	40
Elasticity of:	With respect to							
Breeding herd	Slaughter hog price	0.000	0.027	0.075	0.137	0.204	0.523	0.945
	Corn price	0.000	-0.028	-0.077	-0.140	-0.209	-0.535	-0.969
	Interest rates	0.000	-0.004	-0.011	-0.020	-0.030	-0.077	-0.140
Sow slaughter	Slaughter hog price	0.000	-0.193	-0.248	-0.317	-0.259	0.046	0.506
	Corn price	0.000	0.111	0.112	0.066	0.007	-0.303	-0.772
	Interest rates	0.000	0.060	0.093	0.110	0.102	0.056	-0.013
Pig crop	Slaughter hog price	0.000	0.019	0.051	0.093	0.139	0.357	0.648
	Corn price	0.000	-0.019	-0.053	0.096	-0.143	-0.366	-0.664
	Interest rates	0.000	-0.003	-0.008	-0.014	-0.021	-0.053	-0.096
Barrow and gilt slaughter	Slaughter hog price	0.000	0.000	0.005	0.019	0.048	0.238	0.615
	Corn price	0.000	0.000	-0.005	-0.020	-0.049	-0.243	-0.630
	Interest rates	0.000	0.000	-0.001	-0.003	-0.007	-0.035	-0.091
Farm pork production	Slaughter hog price	-0.017	0.002	-0.003	0.007	0.039	0.241	0.628
	Corn price	0.007	0.012	0.007	-0.011	-0.043	-0.250	-0.645
	Interest rates	0.000	0.006	0.009	0.009	0.004	-0.026	-0.083

Huang, Kuo S. (1985). "Monthly Demand Relationships of U.S. Meat Commodities." *Agricultural Economics Research*, Vol. 37, No. 3, (Summer 1985) pp. 23-29.

Estimated flexibilities of retail prices with respect to wholesale production using monthly data from 1964 to 1979. His estimates are:

Huang's meat demand flexibilities

Flexibility of the price of--	With respect to the wholesale production of--							
	Beef	Veal	Pork	Lamb and mutton	Broilers	Turkeys	Other chicken	Other goods
Sirloin steak	-0.342	-0.006	-0.004	-0.004	0.155	-0.006	0.045	-0.602
Round steak	-0.377	-0.008	-0.027	0.001	0.143	0.012	0.064	-0.645
Chuck roast	-0.508	-0.012	-0.030	-0.009	0.210	0.003	0.075	-0.531
Round roast	-0.332	-0.012	-0.035	0.001	0.140	0.009	0.062	-0.749
Ground beef	-0.418	-0.040	0.073	-0.001	0.168	0.014	0.031	-0.505
Pork chops	0.101	-0.011	-0.581	-0.015	0.286	0.046	0.060	-1.188
Canned ham	0.115	-0.001	-0.207	-0.007	0.096	0.011	-0.021	-0.614
Bacon	0.375	0.008	-0.845	-0.010	0.247	0.033	0.044	-1.020
Sausage	0.100	0.002	-0.457	-0.010	0.219	0.009	0.005	-0.387
Broilers	0.100	0.008	-0.636	-0.002	-0.410	0.033	0.095	-0.868

Huang, Kuo S., and William F. Hahn. (1995). *U.S. Quarterly Demand for Meats.* U.S. Department of Agriculture, Technical Bulletin No. 1841. February 1995.

Using quarterly data from 1979 to 1990, estimated the direct and inverse demand functions for high-quality beef, manufacturing grade beef, pork, and poultry using a theoretically consistent demand system. Estimated the following sets of demand elasticities and flexibilities:

Huang and Hahn's estimates of meat demand elasticities and flexibilities

	With respect to the price of--				
Elasticity of demand for--	High-quality beef	Manufacturing grade beef	Pork	Broiler	Meat expenditure
High-quality beef	-1.036	-0.150	-0.195	-0.135	1.516
Manufacturing grade beef	0.115	-0.401	0.481	0.074	-0.269
Pork	-0.014	0.047	-0.838	-0.077	0.882
Broiler	0.111	0.042	0.044	-0.197	0.001
	With respect to the quantity of--				
Flexibility of price of--	High quality beef	Manufacturing grade beef	Pork	Broiler	Meat expenditure[1]
High quality beef	-0.633	-0.108	-0.036	-0.014	1.000
Manufacturing grade beef	-0.564	-0.225	-0.015	-0.012	1.000
Pork	-0.213	-0.024	-0.803	-0.049	1.000
Broiler	-0.613	-0.115	-0.368	-0.777	1.000

[1] Theoretical restricions force all the meat expenditure elasticities to be 1.

Kesavan, T., Zuhair A. Hassan, Helen H. Jensen, and Stanley R. Johnson. (1993). "Dynamics and Long-Run Structure in U.S. Meat Demand." *Canadian Journal of Agricultural Economics*, Vol. 41, No. 2, (July 1993) pp. 139-153.

Estimated a general, dynamic Almost Ideal Demand System for meats using quarterly data running from 1965 to 1988. (The Almost Ideal Demand System is theoretically consistent). Found the following longrun elasticities of demand:

Kesavan, Hassan, Jensen and Johnson's meat demand elasticities

Longrun elasticity of the demand for--	With respect to the price of--			Meat expend-itures
	Beef	Pork	Chicken	
Beef	-1.02	-0.01	0.00	1.04
Pork	0.15	-0.99	0.12	0.72
Chicken	-0.25	0.02	-1.25	1.48

Marsh, John M. (1991). "Derived Demand Elasticities: Marketing Margin Methods versus an Inverse Demand Model for Choice Beef." *Western Journal of Agricultural Economics*, Vol. 16, no. 2, (December 1991) pp. 382-391.

Compared three different ways of calculating derived demand elasticity for Choice slaughter beef using quarterly data from 1975 to 1987. His preferred estimate for the derived elasticity of demand for choice beef is: -0.66.

Marsh, John M. (1994). "Estimating Intertemporal Supply Response in the Fed Beef Market." *American Journal of Agricultural Economics*, Vol. 76, No. 3, (August 1994) pp 444-453.

Estimated supply elasticities for fed cattle marketing and demand elasticities for feeder calves for three lengths of run using monthly data from January 1978 to June 1991. His estimates are summarized in the following table:

Marsh's fed-cattle supply elasticities

		Elasticities with respect to--		
Dependent variable	Length of run	Fed cattle price	Feeder calf price	Corn price
Fed cattle supply	2 months	-0.170	-0.097	0.072
	18 months	0.606	-0.702	-0.113
	Longrun	3.240	-3.065	-0.744
Feeder calf demand	2 months	0.508	-0.255	-0.029
	18 months	1.167	-0.887	-0.223
	longrun	3.120	-2.760	-0.800

Moschini, Giancarlo, Daniele Moro, and Richard D. Green (1993). "Maintaining and Testing Separability in Demand Systems." *American Journal of Agricultural Economics*, Vol. 76, No. 1, (February 1994) pp. 61-73.

Estimated the demand for food, including meat, using the Rotterdam model and annual data from 1947 to 1978, and tested separability assumptions. (The Rotterdam model is consistent with demand theory.) Found that food was separable from the demand for other products and that meat was separable from the demand for other foods. The demand elasticities for their fully separable model are given below:

Moschini, Moro, and Green's elasticity estimates

	With respect to the price of--							
Elasticity of the demand for--	Non food	Fruits & vege-tables	Ce-reals & bakery	Misc. foods	Beef	Pork	Poul-try & Fish	Income
Nonfood	-0.99	-0.04	-0.03	-0.06	-0.02	-0.02	-0.01	1.16
Fruits & vegetables	-0.03	-0.45	0.06	0.07	0.01	0.00	0.00	0.35
Cereals & bakery	-0.02	0.09	-0.33	0.08	0.00	0.00	0.00	0.17
Miscellaneous foods	-0.03	0.04	0.02	-0.40	0.01	0.00	0.00	0.36
Beef	-0.06	0.00	-0.01	0.00	-0.84	0.14	0.10	0.66
Pork	-0.03	0.00	-0.01	0.00	0.23	-0.72	0.15	0.38
Poultry & Fish	-0.02	0.00	0.00	0.00	0.26	0.23	-0.69	0.22

Moschini, Giancarlo, and Karl D. Meilke (1989). "Modeling the Pattern of Structural Change in U.S. Meat Demand." *American Journal of Agricultural Economics,* Vol. 71, No. 2, (May 1989) pp. 253-261.

Estimated a demand system for beef, pork, chicken, and fish to test for evidence of structural change in meat demand using a theoretically consistent demand system and quarterly data from 1967 to 1987. Their estimates imply that meat demand changed in the 1970's. Their estimated meat demand elasticities after the shift are:

Moschini and Meilke's meat demand elasticity estimates

	Price of--				Meat expend-itures
Elasticity of--	Beef	Pork	Chicken	Fish	
Beef	-1.05	-0.08	-0.13	-0.14	1.39
Pork	0.13	-0.84	-0.09	-0.05	0.85
Chicken	-0.02	-0.07	-0.10	-0.02	0.21
Fish	-0.10	0.01	-0.03	-0.20	0.31

Shonkwiler, J. S., and Suzanne Hinckley (1985). "A Generalized Supply Response/Factor Demand Model and Its Application to the Feeder Cattle Market." *Western Journal of Agricultural Economics*, Vol. 10, No. 2, (December 1985) pp. 245-253.

Estimated the following elasticities for feeder-calf placements in feedlots using bi-monthly data (6 times per year, even nmbered months) from February 1972 to August 1981.

Shonkwiler and Hinckley's elasticity of feeder calf placements with respect to:	
Expected cattle price	1.221
Feeder steer price	-0.909
Corn price	-0.435

Thurman, Walter N. (1987). "The Poultry Market: Demand Stability and Industry Structure." *American Journal of Agricultural Economics*, Vol. 69, No. 1, (February 1987) pp. 30-37.

Estimated direct and indirect demand functions for poultry meat and tested for structural shift in demand using annual data from 1955 to 1981. In addition, did tests that show that poultry price behaves as if the poultry market had a perfectly elastic supply function.

Thurman's poultry meat elasticities of demand with respect to:	
Chicken price	-0.64
Beef price	0.23
Pork price	0.35
Income	0.54

Wohlgenant, Michael K. (1989) "Demand for Farm Output in a Complete System of Demand Functions." *American Journal of Agricultural Economics*, Vol. 71, No. 2, (May 1989) pp. 241-252.

Estimated farm-level demands and farm-to-retail price transmission on the assumption that marketing inputs could be substituted for farm inputs in the production of retail food. Used symmetry, homogeneity, and adding-up restrictions of consumer demand theory to build derived demand system. Found evidence that marketing inputs and farm inputs were substitutes in the production of food. Because of this substitution, farm-level demands are generally more elastic than they would be with fixed proportions. Estimated the following farm-level demand elasticities and flexibilities using annual data from 1956 to 1983:

Wohlgenant's Flexibilities

	Quantities							
Farm price	Beef and veal	Pork	Poultry	Eggs	Dairy	Vegetables	Marketing cost index	Income
Beef and veal	-1.37	-0.17	-1.00	-0.14	0.04	0.00	-1.06	1.42
Pork	-0.27	-2.05	-0.22	0.10	0.00	-0.02	-0.57	1.64
Poultry	-0.50	-0.66	-2.42	-0.34	0.06	-0.18	-1.73	1.68
Eggs	-0.70	0.07	-0.33	-6.71	-0.10	0.07	-5.00	0.29
Dairy	0.00	-0.03	0.01	-0.02	-1.65	-0.02	0.39	0.24
Vegetables	-0.07	-0.12	-0.22	0.11	-0.09	-2.34	-0.98	0.20

Wohlgenant's Elasticities (derived from the flexibilities)

	Farm price							
Quantities	Beef and veal	Pork	Poultry	Eggs	Dairy	Vegetables	Marketing cost index	Income
Beef and veal	-0.76	0.06	0.02	0.02	-0.02	0.00	-0.76	1.02
Pork	0.09	-0.51	0.04	-0.01	0.00	0.00	-0.29	0.64
Poultry	0.10	0.14	-0.42	0.02	0.01	-0.01	0.74	1.13
Eggs	0.08	-0.02	0.02	-0.15	0.01	-0.01	-0.73	-0.05
Dairy	0.00	0.01	0.00	0.00	-0.61	0.01	0.19	0.08
Vegetables	0.01	0.01	0.06	-0.01	0.03	-0.43	-0.16	-0.21

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